Metrics for Service Availability and Service Reliability in Service-oriented Intelligence Information System

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Abstract. Intelligence Information System (IIS) proposed in this paper is based on service-oriented architecture.

This paper gives contribution in definition of metrics for service reliability and service availability in terms of their usage by the end-user. Developed metrics for services have significant meaning for service-oriented Intelligence Information System.

Keywords: SOA, metrics, service availability, service reliability, information system, Intelligence, QoS.

1 Introduction

Contemporary Intelligence models should be based on information-commutation systems. Usage of contemporary ICT technology gives opportunity for more effective implementation of Intelligence function in terms of collecting information, planning information, analyzing information and dissemination.

Qualities of service (QoS) are attributes for services that are used in evaluation of service parameters.

Process of measuring each metric in QoS, should be focus on following:

- What should metrics measure? - (aggregates or percentage);
- How to be measured? - (frequently, periodically or tools);
- Who is responsible for measuring - (service's providers or external service agents);
- Where should metrics be measured (on the end of network, client or web service access point)

Seven QoS attributes are mentioned in [1]: execution time, response time, throughput, scalability, reputation, accessibility and availability.

2 Service Availability

Availability is service attribute, whether or not service is active or available after received request by a user.

Presumption that information system or services in certain period of time are founded in one of numerous service states whether or not services are unavailable or available allows implementing Markov' models.

Analysis for service availability [2] can be based on assumption that availability for services is defined with discrete service states X(t) which means that probability of service transition in other state is equal to result of multiplication by constant λ with time interval Δt when services is founded in state "i" in the time moment t and it transfers in state "j" in time moment t+Δt. Constant "λ" represents number of events in time unit. In a case of service reliability and service availability "λ" is intensity of unavailability or number of service unavailability in time unit.

In the same manner it is possible to define probability of returning in the previous service state. For example, if services were in state "j" in time interval t, then probability of services to be in state "i" in time interval t+Δt is equal to multiplication of constant μ and time interval Δt. Constant μ represent intensity of availability or number of service availability in time unit.

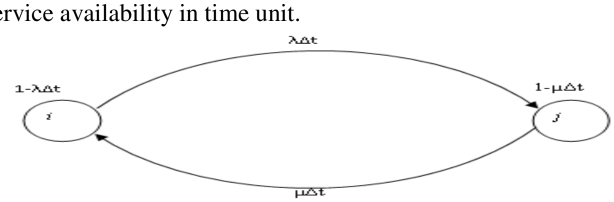

Figure 1. Diagram of transition using different states

Probability in certain time interval that refers to not happen events or service is still in a state "i" after time interval Δt is equal to sum of probability between probability when service was in state "i" in time moment t ($P_i\,(1-\lambda\Delta t)$) and probability when service transits from state "j" in time moment t in state "i" in time moment t+Δt ($P_j(\mu\Delta t)$).

$$P_i\,(t+\Delta t) = P_i\,(t)\,(1-\lambda\Delta t) + P_j\,(t)\mu\Delta t \qquad (1)$$

Probability when service is in state "j" in time interval t+Δt is equal to sum of probability when services was in state "j" in moment "t" ($P_j\,(1-\mu\Delta t)$)and probability when service transits from state "i" in time moment t, in state "j" in time moment t+Δt ($P_i\,(\lambda\Delta t)$)

$$P_j\,(t+\Delta t) = P_i\,(t)\,(\lambda\Delta t) + P_j\,(t)(1-\mu\Delta t) \qquad (2)$$

Function for service availability in certain time moment is presented by following equation:

$$A(t) = \left(1 - \frac{\lambda_{iz}\lambda_{jz}}{r_2 r_1}\right) - \frac{\lambda_{iz}\lambda_{jz}}{r_1 - r_2}\left(\frac{e^{r_1 t}}{r_1} - \frac{e^{r_2 t}}{r_2}\right) \qquad (3)$$

3 Service Reliability

Function of service reliability represents probability of service processing in certain time interval [0,t]. Intensity when service is not available for using can be presented with constant value λ=const.

Our research refers to examination of service reliability and availability in certain time interval [0, t], when numerous request are received in information system from different users.

Function for service reliability in certain time is presented by following equation:

$$R(t) = \frac{r_1 + \mu_{zi} + \lambda_{zj}}{(r_1 - r_2)} e^{r_1 t} - \frac{\mu_{zi} + \lambda_{zj} + r_2}{(r_1 - r_2)} e^{r_2 t} + \frac{\lambda_{iz}}{(r_1 - r_2)} e^{r_1 t} - \frac{\lambda_{iz}}{(r_1 - r_2)} e^{r_2 t} \tag{4}$$

$$R(t) = \frac{r_1 + \mu_{zi} + \lambda_{zj} + \lambda_{iz}}{(r_1 - r_2)} e^{r_1 t} - \frac{\mu_{zi} + \lambda_{zj} + r_2 + \lambda_{iz}}{(r_1 - r_2)} e^{r_2 t} \tag{5}$$

Business process (Figure 2) that is used for presenting functionality of Intelligence Information System shows that intelligence operation should not be launched if in the information system does not have approval for launching that operation.

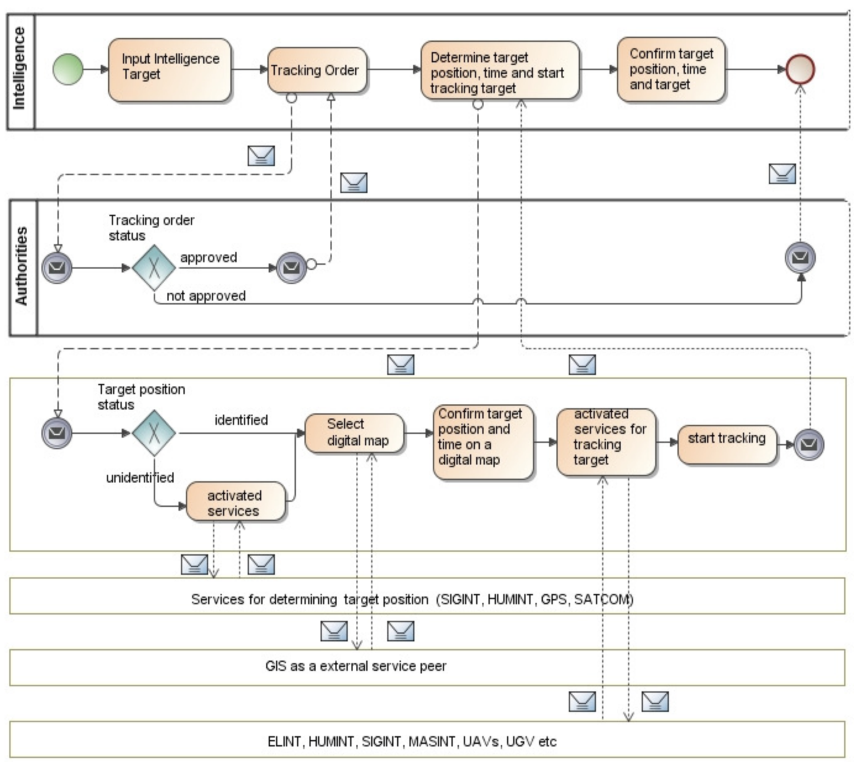

Figure 2. Business process for following Intelligence object

If Intelligence operation is approved by authorities for certain Intelligence target then business process continues on next steps. Next step is determination of position and time on Intelligence target. In our case study, Intelligence operation refers to follow Intelligence target.

Position of Intelligence target can be determinate when services that are components of Intelligence Information System or peers of external service providers are activated.

Using services from external peers refers to future of Intelligence which means that in a future is possible to be exploited services that will be on a higher level than at this moment.

Services for tracking target are activated immediately when position of Intelligence object is marked on a digital map.

Common characteristic for previously mentioned services is probability that refers to service availability in certain time during Intelligence operation. Also, zones (green, yellow, red) for determining functions of probability can be introduced (see figure 3).

Service availability	Zones
service is available for using	
service can be available for using	
service cannot be available for using	

Figure 3. Service availability that is related to appropriate zones

Probability value of service availability allows selecting services that can be exploited in certain Intelligence operation in certain time. Introduced zones contribute to select services that can respond on the most appropriate manner.

4 Conclusion

Information that is collected by the services when time is not taken into consideration has lower financial costs, because information is collected directly from Intelligence sources or services (video camera, UAVs, satellite, air etc).

In this paper we present estimation of probability for services in certain time moment by determination of service reliability and service availability. Estimating mentioned QoS attributes allow services to be exploited in the most appropriate manner. This contributes to achieve high service optimization for executing Intelligence operations.

References

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